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(19)

(54) IMPROVEMENTS IN AND RELATING TO A METHOD OF MAKING CONTAINERS

(71) We, AIRFIX INDUSTRIES LIMITED, a British Company, of 17 Old Court Place, London W.8, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which is to be performed, to be particularly described in and by the following statement:—

The present invention relates to improvements in methods of making containers using injection moulding and to improved containers.

It is well known to make containers by injection moulding a whole container at one time. As a general proposition this method of making containers has a number of limitations as regards containers capable of being formed by such methods. For example, there is a relatively high lower limit on the thickness of the walls of a container made by this method both because of the difficulty of getting injected material to the extremities of thin cavities and because of the tendency with time of the male mould to move off-centre relative to the female mould. It will be appreciated that only small variations in thickness of wall portions of thin wall containers will produce an unacceptably thin wall portion and consequently, an unacceptable container.

Further, such injection moulded containers have to be provided with printed surface decoration when manufactured so that the printing must be done "in the round". This manner of printing is expensive and also greatly limits the type of printed decoration which can be applied to the container with consequent reduction in the commercial value of the container as far as trade and consumer appeal is concerned.

A further disadvantage of such injection moulded plastics containers for packaging edible products is that, unless great care is taken in moulding, the resultant container will taint food or drink with a "plastic taste". This tainting arises from a number of different causes dependent on the type of material which is used. For example, in injection moulding polymerised plastics material, e.g. polystyrene, the shear forces produced in the material as it is injected into the mould break up the polymer chain and release the monomer, styrene, from which the material is polymerised. The presence of this free monomer as well as other residual volatiles in the polymer contributes to the tainting of food in contact with the plastics material. A percentage of free monomer in the polymer of about 0.05% is an acceptable level of free monomer, though a level may for some uses be acceptable at about 0.25%. The percentage of free monomer in the polymerised material before moulding may vary between about 0.05% to 0.5% dependent on the polymerisation process and

subsequent processing, e.g. extrusion for the addition of pigments to the polymerised material. Whatever the initial percentage of free monomer, this percentage is inevitably increased by injection moulding and may be increased to a level which is unacceptable for certain foods and to certain traders.

In injection moulding containers from plastics materials such as polyethylene and polypropylene, tainting can arise from the presence in the moulded material of degradation products produced by the effects of the high temperatures required for injection moulding. Again, the lower the percentage of degradation products the less tainting of the contained material.

As an alternative to injection moulding a container in a single step it has been proposed in U.K. Patent Specification No. 1,049,592, and particularly for large relatively rigid containers, to, in effect, sub-divide a container base and side walls into smaller shaped parts, form these parts first and then unite the parts by injection moulded seams of the same thickness as the parts. This proposal would appear to have the same disadvantages as has simple injection moulding and additionally presents great difficulties, both practical and economic, in the exact positioning of the pre-shaped parts in the correct position in a mould cavity.

It has also been proposed in U.K. Patent Specification No. 976,635 to make a generally rectangular cross-section container from a blank of relatively flexible material, e.g. cardboard, formed with a base portion from which discrete side wall portions extend, the blank being folded up to form the base and four side walls of a container, the side walls being united with each other and, if necessary, the base along adjacent edges by injection moulded seams. However, no practical and economic method has been found for inserting such a blank into a mould cavity for the production of the injection moulded seams. Additionally, this method is only applicable to polygonal containers. Further, with this form of blank there is a relatively high wastage of material in cutting out the blank.

It has also been proposed to form a cylindrical container by injecting moulding material along juxtaposed edges of a rolled sheet to form a seam, the edges being clamped in a clamp defining the seam. No practical method has been found of introducing the edges of the sheet into the mould.

It is an object of the invention to provide a method of making a container whereby the above disadvantages of prior art methods are obviated and to provide an improved container.

According to one aspect of the present invention there is provided a container comprising a peripheral wall formed from a blank of resilient flexible sheet material deformed so that two opposite side edges of the blank are juxtaposed and so that it provides a continuous peripheral wall for the container extending about a region, the cross-sectional area of which decreases toward one of the opposite ends of the blank, an end enclosure adjacent the end of the blank toward which the cross-sectional area decreases and a unitary one-piece injection moulding of synthetic plastics material which comprises an end closure portion uniting the blank to the end closure and constraining that end of the blank to the desired configuration, a portion adjacent the end of the blank remote from the end closure and constraining the blank at that end to the desired configuration and a seam seaming the two juxtaposed side edges and joining the end closure portion and the portion adjacent the end of the blank remote from the end closure, wherein the seam is formed on the inner surfaces of the juxtaposed edge portions of the blank, and the portion of the moulding at the end of the blank remote from the end closure forms a lip at that end of the container, which lip includes a free edge, a first part extending from the free edge toward the end closure and formed on the inner surface of the blank, and a second part projecting laterally of the container from the first part the second part being of a thickness in the direction between the free edge and end closure which is less than the thickness of the first part in the direction from the inside to the outside of the container.

According to another aspect of the present invention there is provided a method of making a container defined in the preceding paragraph in which a peripheral wall is formed and seamed and is provided with an end closure, the method comprising providing a mould cavity which corresponds in shape to the shape of the container including a part corresponding to an end closure, a part corresponding to a peripheral wall surrounding a zone of decreasing cross-sectional area in a direction toward the end closure, a part corresponding to and end closure portion of uniting the peripheral wall to the end closure and for constraining the peripheral wall at the closed end to the desired configuration, a part corresponding to a portion adjacent the end remote from the end closure for constraining the peripheral wall to the desired configuration at the end remote from the end closure and a part corresponding to a seam extending between the end closure portion and the portion adjacent the end remote from the end closure portion, inserting a resilient flexible blank into the cavity so as to extend at least around the cavity part corresponding to the peripheral wall and to have opposite sides edges juxtaposed and adjacent the cavity part corresponding to the seam, injectiong synthetic plastics material into the parts of the mould cavity unoccupied by the blank and

any second blank to form the unitary one-piece moulding on the blank, the seam of the one-piece moulding extending on the inner surface of the blank, and removin gthe composite container formed by the blank or blanks and the moulding from the mould cavity, wherein the cavity part, which corresponds to a portion adjacent the end remote from the end closure, corresponds to a lip for the container, which lip includes a free edge, a first part extending toward the end closure for forming an injection moulding on the inner surface of the blank and a second part projecting from the first part laterally of the container, the second part being of a thickness in the direction between the free edge and end closure which is less than the thickness of the injection moulding formed by the first part in the direction from the inside to the outside of the container.

The side wall of the container may be further strengthened and sustained by ribs injection moulded on to the blank surface and extending the length of the container side wall.

A container made according to the invention may have a flexible side wall of any desirable thickness. The thickness can be determined by the mechanical strength requirements for the container or can be thinner and reinforced by longitudinally extending ribs.

Since the side wall of the container is formed substantially entirely by the piece of sheet material, the sheet piece can be printed with the desired decoration before use and in the flat. This allows the use of advanced printing and finishing techniques resulting in a much improved container which can economically be thus given greater trade and consumer appeal.

Because the container walls can be much thinner than heretofore, the container is cheaper although of much improved appearance.

Additionally, there is no limitation on the transverse section of a container made by a method according to the invention; for example, the container section can be round, oval, etc. or polygonal or part polygonal, or the container may be polygonal at its base and round, oval, etc. at its top. The shape of the container is determined by the shape of the mould cavity into which the sheet piece is inserted, the sheet piece being constrained to this shape by the injection moulding at relevant positions on the container wall. For example, in making a container having two side wall portions meeting at a corner, a part of the moulding may be provided along the corner to maintain the angular shape of the container. Additionally, the sheet piece may be provided with a line of weakening, e.g. perforations, scoring, a cut-out or the like along the corner, to assist bending of the sheet material. The corner may extend part way or fully between the top and base edges of the container.

In making a plastics container according to the invention for packaging edible products, the container side wall made of plastics sheet is not subjected during manufacture to the degrading processes to which the injection moulded material is subjected, i.e. shearing forces and high temperatures, so that the percentage of tainting agents in the sheet is substantially not increased in making up the container. The proportion of the container wall which may be made of preformed plastics sheet is relatively high so that a greater proportion of, e.g. degradation products or free monomers can be accommodated in the injection moulded material without the total proportion becoming unacceptable.

The plastics sheet may, for example, be biaxially oriented polystyrene sheet made, for example by a suspension process which will have a relatively low free monomer content.

In addition to controlling the percentage of tainting agents in the plastics material from which the container is made, it is also important to have as low a total amount of tainting agents as possible. The above described container may also have a considerably reduced total because the thickness of the foil can be considerably less than the wall thickness of a conventional injection moulded container. Thus the container has less plastics material than a conventional container and there is a reduced total of free monomers or degradation products in the container walls.

A container according to the invention may be provided with an end closure which may be made wholely by injection moulding or formed of a piece of flexible sheet material connected to the container side wall by an injection moulding, these injection mouldings being formed integrally with the seam moulding, or may be formed by one or more pieces of flexible sheet material integral with that forming the side wall. This end closure may form the base or top of the completely closed container.

In making such a container, material to be injection moulded is injected into the mould cavity at one end of the container, generally centrally of the end closure of the container. The material then has to flow rapidly around the mould channel forming the end closure (or lip as the case may be), along the channel forming the side wall seam rib and finally the channel forming the lip (or end closure as the case may be). Since the side wall seam rib channel is relatively narrow and the lip or end closure seam channel equally narrow as well as long, the moulding material has to be injected into the mould at relatively high pressure to ensure that all channels are filled via the side wall rib channel. Such high pressures put undesirable stresses on the injection moulding apparatus.

To obviate this disadvantage such a con-

tainer may be formed with an injection moulding branching off from the seam rib moulding towards either the lip or end closure moulding in order to provide, when it is being formed, a second point of entry of injection moulding material into the channel defining the lip or end closure moulding, whichever is most remote from the point of entry of the injection moulding material into the mould. This has the result that the pressure of the injected material can be reduced and yet a complete moulding can be obtained.

The seam rib moulding and moulding branching therefrom may be arranged to be symmetrical relative to the container axis, for example in the form of a V, U or Y.

According to the present invention there is further provided a method of making a container comprising preparing an uncreased blank of flexible resilient material having concentric end edges and divergent side edges lying on radii from the centre of the end edges, deforming the blank to juxtapose the side edges and thereby form a peripheral wall bounding a region whose cross-sectional area decreases towards the shorter of the two end edges, constraining the deformed blank against its own resilience in a female mould tool, inserting a male mould tool into the female tool and trapping the blank between the tools so that the blank occupies a mould cavity part which corresponds to the container peripheral wall with the side edges adjacent another part which corresponds to a seam to be formed on the inner surface of the blank to unite the side edges, with one end edge adjacent a cavity part corresponding to an end closure, with the other end edge adjacent a cavity part which corresponds to a container lip including a free edge, a first part extending on the inner surface of the blank towards the end closure, and a second part projecting from the first part laterally of the container, the second part being of a thickness in the direction between the free edge end the end closure which is less than the thickness of the first part in the direction from the inside to the outside of the container, and with the blank spanning a part corresponding to a reinforcing rib extending between the end closure and the lip, injecting synthetic plastics material into the mould cavity parts unoccupied by the blank and removing from the mould cavity the complete container in which the moulding is a one-piece unitary moulding bonded to the blank, seaming the side edges of the blank, forming an end closure for the space bounded by the wall, constraining the blank at the open end of the container to the desired shape and providing reinforcement for the blank at the seam and at the rib.

Further features and advantages of the present invention will become apparent from the following description of embodiments thereof, given by way of example only, with reference to the accompanying drawings, in which:—

Figure 1 is a diametrical section through one embodiment of a container in accordance with the invention;

Figure 2 is a plan view of a piece of sheet material from which the side wall of the container of Figure 1 is made;

Figure 3 is a section through the container of Figure 1 on the line A—A;

Figure 4 is a diametrical section through another embodiment of a container in accordance with the invention;

Figure 5 is a diametrical section through part of a further embodiment of a container in accordance with the invention;

Figure 6 is a section through part of a mould tool for making the container of Figure 5;

Figure 7 is a diametrical section through another embodiment of a container in accordance with the invention;

Figure 8 is a plan view from underneath the container of Figure 7;

Figure 9 is a plan view of a piece of sheet material from which the side wall of the container Figure 7 is made up;

Figure 10 is a section through part of a mould tool for making another container in accordance with the invention;

Figure 11 is a plan view of a piece of sheet material from which the side walls of a square section container according to the invention may be made up;

Figure 12 is a plan view of another container in accordance with the invention;

Figure 13 is a plan view of a blank for making another container in accordance with the invention;

Figure 14 is a plan view of the end closure of a container made from the blank of Figure 13;

Figure 15 is a plan view of another blank for making another container in accordance with the invention;

Figure 16 is a plan view of a series of blanks for making another form of container in accordance with the invention;

Figure 17 is a section through a mould tool for use in making a container from the blanks shown in Figure 16, the section being taken along the line XX—XX of Figure 18;

Figure 18 is an axial section through the mould tool of Figure 17;

Figure 19 is a section through a lid;

Figure 20 is a plan view of the lid of Figure 19, and

Figures 21 and 22 are a section and plan from beneath respectively of another embodiment of lid.

Referring to Figures 1 to 3, the container comprises a side wall 1 formed of a single piece of flexible sheet material 2 whose opposed marginal portions are joined by an injection moulded seam or rib 3, which also sustains the sheet piece 2 axially. The rib 3 projects from the inner surface of the side

wall 1. The end closure 4 of the container may be formed, as shown, wholly by an injection moulding integral with the seam rib 3, or it may be formed of a piece of flexible sheet material which is joined at its circumferential margin to the margin of one end of the side wall 1 by an injection moulding. The end closure injection moulding in both these alternatives acts to constrain the sheet piece 2 at the closed end of the container to the required shape and to hold it relative to the end closure.

To further axially sustain the sheet piece 2, additional ribs 3' (Figure 4) may be injection moulded onto the inner surface of the sheet, the ribs 3' extending between the injection moulding at the base of the container and the container open end. Preferably three such ribs 3' are provided equally spaced with the rib 3 around the side wall of the container.

A lip 7 is injection moulded onto the side wall adjacent the open end of the container at the same time as the rib 3, ribs 3', if provided, and end closure 4 are formed. The lip 7 acts to constrain the sheet piece to the required shape at the open end of the container.

As shown in Figure 4, the moulded lip 7 comprises a portion *7a* extending axially of the container and a portion *7b* extending radially of the container. To ensure that the sheet 2 is forced to lie, as shown, continuously along the outer surface of the lip 7 in the region of portion *7a*, the mould cavity defining the lip is dimensioned such that the radial dimension of portion *7a* is at least equal to the axial dimension of portion *7b*. If these relative dimensions are not adhered to, it is found that moulding material will flow up the mould cavity defining rib 3 (or 3') into the cavity defining lip portion *7a*, then some of the material will flow to the radially outer side of the sheet 2 when it flows into the portion *7b*. If sheet 2 is colour printed this effect will result in a sub-standard appearance for the finished container.

Projections 4' may be formed on the ribs 3, 3' for facilitating stacking of the containers. The container may be formed with a handle integral with a rib 3 or 3' or a spout integral with the lip 7. The closed end 4 of the container may form the container base or may form the container top closure, the base being formed after filling.

The sheet piece 2, Figure 2, is cut to provide the required shape of side wall, the curvature of the foil in the flat depending on the desired conicity of the side wall.

The container is formed by inserting the piece of sheet material 2 into a female mould cavity and then introducing the male mould core therein. The sheet piece is located in the side wall defining part of the container defining cavity, between the male and female moulds, and will be constrained thereby to the required shape. Channels formed in the female and/or male mould walls define the injection moulded part of the base 4, the rib 3, ribs 3', if provided, and lip 7. Material is injected into these channels to complete the container.

To further strengthen the container side wall and constrain the sheet piece forming the side wall to the required shape of any of the above described containers, at least one circumferentially extending rib may be moulded on the container side wall intermediate the ends of the container.

Such a container comprises a side wall sheet piece 2, Figure 5, an end closure 4, a lip 7, longitudinal ribs 3, 3', one of which, 3, forms a seam, and circumferential ribs 65. The container is made by axially feeding the sheet piece 2 into a cavity 66, Figure 6, of a female mould member 67.

The foil is trapped in the moulding cavity between a male mould member 68, advanced into the female mould cavity, and the female member. The male member defines with the female member an annular moulding cavity, occupied by the sheet piece 2, and an end closure cavity 69.

Each of the longitudinal rib cavities is defined by a channel 70 in the male member and a channel 70*a* in the female member, these channels tapering oppositely in radial thickness on either side of the annular sheet piece cavity. The, or each of a number of, circumferential rib cavities 71 is of parallelogram section and the annular sheet piece cavity is stepped at the region of the or each circumferential rib cavity. A lip cavity 72 will define the lip 7. When material is injected at the base of the mould cavity it travels up the inside of the sheet piece 2 in channels 70 forcing the sheet outwardly into channels 70*a* and also fills the or each circumferential rib cavity 71 and the lip cavity 72. The material in the cavity forming the seam rib will bond the adjacent edges of the sheet piece in the region of that cavity.

Whilst the end closure has been described as injection moulded, it may be formed by a sheet piece connected by an injection moulding to the side wall, or in the case of a polygonal container, by one or more panels connected to the wall panels, as hereinafter described.

There is shown in Figures 7 to 9 a further embodiment of a container in which the juxtaposed edges 24 of a piece of sheet material 23 forming the container side wall 21 are united by an injection moulded rib 25 on the inner surface of the side wall 21. The edges 24 of the piece 23 are shaped so that the rib 25 has two branches *25a*, *25b*, one branch *25a* extending along a generatrix of the container side wall, and the other branch *25b* diverging from the generatrix. From the junction of the branches *25a*, *25b* a further

injection moulded rib 26 extends to adjacent the top edge of the side wall on the inner surface thereof. The container end closure 22 is formed by a piece of foil 27 which is connected to the side wall 21 by an injection moulding 28 integral with moulding 25. In a modification the end closure 22 may be made wholely by injection moulding.

The container is also provided with an injection moulded lip 29 integral with moulding 25 and moulding 26. The mouldings 25, 26 and 27 again act to constrain the sheet piece 23 to the required shape.

The above described container is made in a mould into which material is injected at the centre point 30 of the end closure of the container. Material flows from centre point 30 along two channels forming diametrical connecting mouldings 31, formed on the undersurface of the foil 27, to the channel defining moulding branch 25*a* and from there along the two channels defining moulding branch 25*b* and rib 26 to the channel defining the lip 29. The material thus enters this latter channel, which is most remote from centre point 30, at two angularly spaced points and flows from both these points around the lip channel.

The configuration, angle of divergence and point of divergence of the moulding branch 25*b* and rib 26 can be varied as required practically and aesthetically.

For larger containers the rib 25 can be repeated one or more times around the side wall to provide the requisite number of entry points for the injected material into the lip channel to provide a good moulding at reasonable injection pressures. Additionally these ribs also act to sustain the container side wall.

As described in the above embodiment, the moulding material is injected initially into the end closure channel of the container mould; it may alternatively be injected initially into the rim channel. In this latter case the Y-shaped moulding is inverted to provide two points of entry into the end closure channel.

Although the above described containers are described and shown as having circular cross-sections, they may be made with oval, polygonal, part polygon sections or they may be made with sections which change in the axial direction from polygon to round or oval, by suitable selection of the mould tools.

In making the mould tools for a polygonal container the mould channels defining the container ribs 3 and 3′ are made in the male mould tool so that the container side wall is provided with shape sustaining ribs at its corners. In the case where these corners are radiused rather than sharp, difficulty is found in grinding the appropriate channel at the required position in the curve of the corner on the mould tool. It is therefore proposed to extend the channel around the corner so that it starts on the plane face of the mould tool and extends onto the adjacent plane face of the mould tool. These extensions of the basic channel are of reduced depth. Such an arrangement is shown in Figure 10 for a square section container. The female tool 80 is provided with a square section cavity with radiused corners 81. The male tool 82 starts with a corresponding shape and is thereafter ground at the corners 83 to provide a main channel 84 defining a rib (3 or 3′) with lateral extensions 85 of lesser depth than the channel 84, the extensions extending from channel 84 onto the adjacent plane surfaces of the tool 82. As shown a sheet piece 2 is inserted in the cavity between the mould tools.

In the resulting container the mouldings which are extensions of the ribs assist the ribs and moulded lip and end closure in maintaining the container shape.

In making a polygonal section container which has relatively sharp apices, it is found desirable to weaken the sheet piece in the region of the apices so that the sheet piece will more readily take up the shape of the mould cavity. Such weakening may be provided by scoring, perforating or cutting the sheet piece, or indeed by cutting portions out of the sheet piece, at those portions which will lie at the apices of the polygon. In forming the container the ribs 3, 3′ will be formed along these lines of weakening to restrengthen the sheet piece and assist in constraining the sheet piece to the required polygonal section.

There is shown in Figure 11 a piece of sheet material 10 for use in making a container with a square transverse section. The side walls of the container are constituted by portions 10*a*, 10*b*, 10*c* and 10*d* which are corrected by bridging portions 11, defined by cut-outs 12, 13, 14 extending radially of the piece 10 in the flat. These lines of weakening provided by the cut-outs 12 to 14 in the piece 10 allow the sheet material to bend with greater facility when it is inserted in the mould cavity. After insertion, material is injected along the lines of weakening and the juxtaposed edges 15 of the piece 10 to complete the container side wall. At the same time the container is provided with an end closure and a lip as hereinbefore described.

In the above described containers, the end closure is formed either wholely by an injection moulding or by a piece of sheet material which is connected to the edge of the side wall by an injection moulding. In the former method, the injection moulding is of uniform thickness. It has been found that the end closure thus formed is thicker (i.e. stronger) than it need be. However, because in the majority of cases the injection point is at the centre of the end closure of the container, the end closure defining mould cavity must be sufficiently thick to allow the injected material to flow quickly and easily to the rest of the container mould cavity. To reduce the overall end closure thickness but yet allow sufficient flow of the in-

jected material it is proposed to form the cavity with preferential flow paths for the injected material and reduce the thickness of the rest of the cavity. This produces a ribbed effect on the end closure which lends strength to the rest of the end closure. There is shown in Figure 12 an example of such an end closure for a square container. Material is injected into the end closure mould cavity at 90. The ribs 91, projecting from one or both sides of the end closure plane and extending diagonally from point 90, form the preferential flow paths to the side wall ribs 3, 3' which are formed as described with reference to Figure 10. The portions of the end closure between the ribs 91 are of reduced thickness. Clearly when providing any other shape of container with such an end closure the ribs 91 will be arranged to direct injected material to the side walls in the most advantageous manner. Where the container is formed with a single side wall seam rib 3' (or 25, 26 as shown in Figure 7) one of the ribs 91 will direct material towards this rib 3' (or 25, 26), further ribs 91 being provided as required radiating from the injection point.

In the above described containers, and particularly those having a polygonal section, the base is formed separately of the side wall sheet piece. In a modification of the invention the container is made using a piece of flexible sheet material which is cut to define a plurality of side-by-side wall panel means and a plurality of base panel means extending from an edge of a side panel means. The blank is adapted to be formed so that the side panel means define at least a part of a peripheral wall of the container adjacent the base and the base panel means when folded inwardly from the side panel means form a base part. Injection moulded seams unite the free edges of the side panel means and base panel means.

Figures 13 to 15 show embodiments of such a blank. The blank comprises four side wall panels 101, 102, 103, 104 each of which is slightly tapered and carries at the smaller end a triangular base panel 105. The blank can be folded along the lines defining the panels, which lines may be weakened as described in connection with the embodiment of Figure 11. This folding gives a tube of rectangular section. The base panels 5 can then be folded inwards to form a base.

The blank is positioned in a female mould cavity and trapped there by the male mould member, material is injected through the female mould member, and into the moulding cavity advantageously at the junction of the free edges of the various base panels in the centre of the base. Seam defining channels of the male member allow the injected material to run along seams 106 radiating from the injection point, along a channel which defines the seam rib 107 at the adjacent free edges of the folded side wall panels and along channels defining ribs along the fold lines if required and if the fold lines have been weakened.

The container may be polygonal only in the base region in which case a blank may be used as shown in Figure 15. Here the side wall panels are defined by cuts 110 extending only partially along the length of the blank but again each carries a base panel 111. The part of the container remote from the base will be generally cylindrical but slightly convex externally. In addition to the seam rib, ribs will be formed to cover the cuts 110.

Both of the containers described can nest and both can be produced with very little wastage of foil, either where cut from a foil as shown by broken lines in Figure 13 and with even less wastage if two end-to-end foils are cut from a wider foil strip, the base panels then being partially interdigitated. While rectangular containers have been described, other polygonal forms are equally possible.

To substantially obviate wastage of foil which occurs when cutting the blanks for the embodiments described with reference to Figures 11 and 13 to 15, it is proposed to make a nestable container from a foil blank which is cut to define a plurality of side-by-side, parallel sided interconnected panels. Cuts are made in the blank between the panels and the blank is located in a mould cavity corresponding in shape to the container to be produced with the cut panel edges diverging in the direction of the open end of the container. The cut edges of the panels are then joined by injection moulded seams.

The container can thus be made without any foil wastage as the full width of a basic strip can be utilised, even where each panel includes a base panel element as described in connection with Figures 13 to 15.

Figures 16 to 18 show a blank for making a square sectioned contained without wastage. The blank includes four rectangular side by side panels 121, each connected to its neighbour over a part 122 and separated therefrom over a part 123, and four base panel elements 124. Two rows of foil blanks are cut simultaneously from a strip 125, as by a cutting cylinder, the foils being oppositely oriented so that there is no wastage. Edge-to-edge foils along the strip are separated from one another by a cut 126 and end-to-end foils across the strip are separated by a cut 127.

The sheet blank is constrained to the shape of the cavity defined by male and female mould tools 128, 129 and corresponding to the shape of the container to be produced. The tools cause the separated parts of the side panels 121 to diverge from the axis of the tool, and hold the base panel elements 124 in a plane substantially normal to the tool axis. Material is then injected at 130 to form seams between neighbouring base panel elements, along channels 131 at each corner of the container

cavity to form V-shaped, panel bonding corner seam ribs, the wider part of each being remote from the base, and a lip 131*a* around the edge of the sheet blank remote from the base. The channels 131 are formed in the male tool at the seam regions to provide seams projecting beyond the inner face of the container walls at the corners.

The seams may be parallel sided instead of V-shaped if desired.

In making the above described containers naany suitable means may be used to insert a piece of flexible sheet material into the mould cavity, and in particular this may be effected by a suction pad able to draw the piece from a store and deposit it in the mould cavity where its resilience will at least in part hold it in position. If necessary ancilliary means such as vacuum may be applied through the mould wall to improve positioning. Upon positioning the sheet piece, the male mould may be introduced into the cavity and the male and female moulds will define the required channels for the moulding material injected into the cavity.

At present it is preferred to use a rotatable spigot having a section corresponding to that of the cavity as the pad, to which the sheet piece is fed tangentially, the leading edge portion of the sheet piece being attached to the spigot, for example, by suction and the sheet piece being wrapped round the spigot at it is rotated. The spigot is then inserted into the female mould part and the suction released so that the sheet piece is released from the spigot and takes up its position against the wall of the female mould part. A moulding machine with a spigot feed apparatus is described in our copending United Kingdom patent application No. 25319/73.

In the cases of sheet pieces including base panels, these panels may be folded over the leading end of the spigot by air jets and held in place by suction.

Instead of placing the sheet piece in the female mould cavity by using a spigot, the male mould core may be used.

As an alternative to the above methods of introducing the sheet piece into the female cavity, the sheet piece may be blown or pushed radially into an intermediate open ended cavity through an axially extruding slot in the cavity wall, the piece then being pushed axially out of its cavity into the female cavity.

A similar procedure as above described may be adopted in respect of a lid for the container. Referring to Figure 19, the lid comprises a flexible sheet member 47 forming a cover part and a sheet member 48 forming a lid skirt. The cover part 47 and skirt 48 are united by a moulding 49 and the skirt may be formed with a recess 50 to snap on to a lip or bead injection moulded onto the container.

It may be desirable to reinforce the member 47 in the lid and this may be effected as for the container side wall by injection moulding a reinforcement, such as ribs or radial spokes 51 on the member (Figure 20).

Referring to Figures 21 and 22 an alternative form of lid is shown which comprises a flexible sheet cover part 52 and injection moulded rim part 53 having an internal container engaging recess 54. This lid may also be provided with injection moulded reinforcing ribs 55.

The flexible sheet material from which the side walls and if required the bases of the above described containers and the lids are formed may be a synthetic plastics or metal foil, paper, board or any suitable flexible laminate or coated flexible sheet material, whether impervious or pervious. It may be plain or printed and translucent or opaque as required. The sheet piece forming the container side wall may also be made up of two or more different flexible sheet materials, e.g. plastics foil and board, united by any suitable means before use, printed as required.

WHAT WE CLAIM IS:—

1. A container comprising a peripheral wall formed from a blank of resilient flexible sheet material deformed so that two opposite side edges of the blank are juxtaposed and so that it provides a continuous peripheral wall for the container extending about a region the cross-sectional area of which decreases toward one of the opposite ends of the blank, an end closure adjacent the end of the blank toward which the cross-sectional area decreases and a unitary one-piece injection moulding of synthetic plastics material which comprises an end closure portion uniting the blank to the end closure constraining that end of the blank to the desired configuration, a portion adjacent the end of the blank remote from the end closure and constraining the blank at that end to the desired configuration and a seam seaming the two juxtaposed side edges and joining the end closure portion and the portion adjacent the end of the blank remote from the end closure, wherein the seam is formed on the inner surfaces of the juxtaposed edge portions of the blank, and the portion of the moulding at the end of the blank remote from the end closure forms a lip at that end of the container, which lip includes a free edge, a first part extending from the free edge toward the end closure and formed on the inner surface of the blank, and a second part projecting laterally of the container from the first part, the second part being of a thickness in the direction between the free edge and end closure which is less than the thickness of the first part in the direction from the inside to the outside of the container.

2. A container according to claim 1 in which the injection moulding has been formed on the blank so as to adhere thereto.

3. A container according to either claim 1 or claim 2 in which the moulding includes a plurality of ribs extending between the end closure part and the part remote from the end closure, one of the ribs forming the seam.

4. A container according to any of claims 1 to 3 in which the seam or at least one of the ribs is a bifurcated element of the moulding.

5. A container according to any of the preceding claims in which the wall is uncreased.

6. A container according to any of the preceding claims in which the blank in the undeformed state has two concentric end edges extending between the side edges which themselves lie on radii of the end edges.

7. A container according to any of claims 1 to 4 wherein the container is polygonal in transverse section at least adjacent the end closure and the apices of the polygon are radiused, the unitary moulding including at least one rib extending along an apex of the container, the rib having a section transverse to the direction between the container ends which includes a relatively thick portion substantially centrally of the radiused apex and thinner portions on either side thereof extending transversely to the adjacent planar portions of the container peripheral wall.

8. A container according to any of claims 1 to 4, wherein the container is polygonal in transverse section at least adjacent the end closure and ths peripheral wall is folded to form a plurality of wall panels, the unitary moulding including a rib extending along each fold.

9. A container according to claim 8 wherein the wall panels are generally rectangular and part of adjacent edges of the wall panels diverge from each other in a direction away from the end closure, those parts of the adjacent edges of the wall panels being united by ribs forming part of the unitary injection moulding.

10. A container according to any of the preceding claims in which the end closure is a part of the unitary one-piece injection moulding.

11. A container according to claim 10 in which the end closure includes ribs which radiate from the centre of the end closure and are thicker than the end closure therebetween.

12. A container according to any of claims 1 to 9 wherein the end closure includes flexible sheet material.

13. A container according to claim 12, wherein the end closure includes a piece of flexible sheet material seamed to the peripheral wall by an injection moulding constraining the peripheral wall and end closure to a predetermined shape at the closed end of the container.

14. A container according to claim 12 when dependent on claim 7 or claim 8 wherein the end closure includes an end closure panel coupled to each wall panel, folded relative thereto and seamed to the adjacent end closure panel by the end closure portion of the unitary moulding.

15. A container according to claim 12 when dependent on claim 7 or claim 8 wherein the end closure includes a single panel coupled to one wall panel, folded relative thereto and seamed to the peripheral wall by the end closure portion of the unitary moulding.

16. A container according to any of the preceding claims, wherein the unitary injection moulding includes a peripheral rib extending around the peripheral wall intermediate the ends of the container and constraining the wall to a predetermined shape.

17. A container according to any of the preceding claims, comprising a closure formed by a piece of flexible sheet material provided with a skirt formed by an injection moulding.

18. A container according to claim 17, wherein the sheet piece is provided with injection moulded ribs.

19. A container according to any of the preceding claims, wherein the flexible sheet material is synthetic plastics or metal foil, paper, board or a flexible laminate.

20. A method of making a container according to claim 1 in which a peripheral wall is formed and seamed and is provided with an end closure, the method comprising providing a mould cavity which corresponds in shape to the shape of the container including a part corresponding to and end closure, a part corresponding to a peripheral wall surrounding a zone of decreasing cross-sectional area in a direction toward the end closure, a part corresponding to an end closure portion for uniting the peripheral wall to the end closure and for constraining the peripheral wall at the closed end to the desired configuration, a part corresponding to a portion adjacent the end remote from the end closure for constraining the peripheral wall to the desired configuration at the end remote from the end closure and a part corresponding to a seam extending between the end closure portion and the portion adjacent the end remote from the end closure portion, inserting a resilient flexible blank into the cavity so as to extend at least around the cavity part corresponding to the peripheral wall and to have opposite side edges juxtaposed and adjacent the cavity part corresponding to the seam, injecting synthetic plastics material into the parts of the mould cavity unoccupied by the blank and any second blank to form the unitary one-piece moulding on the blank, the seam of the one-piece moulding extending on the inner slrface of the blank, and removing the composite container formed by the blank or blanks and the moulding from the mould cavity, wherein the cavity part, which

corresponds to a portion adjacent the end remote from the end closure, corresponds to a lip for the container, which lip includes a free edge, a first part extending toward the end closure for forming an injection moulding on the inner surface of the blank and a second part projecting from the first part laterally of the container, the second part being of a thickness in the direction between the free edge and end closure which is less than the thickness of the injection moulding formed by the first part in the direction from the inside to the outside of the container.

21. A method according to claim 20 in which the injection moulding adheres to the blank.

22. A method according to either claim 20 or claim 21 in which the cavity includes parts corresponding to a plurality of ribs extending between the end closure part and the part remote from the end closure, one of the ribs forming the seam.

23. A method according to any of claims 20 to 22 in which the cavity part corresponding to the seam or one at least of the ribs corresponds to a bifurcated element of the moulding.

24. A method according to any of claims 20 to 23 in which the blank is uncreased.

25. A method according to any of claims 20 to 24 in which the blank has opposite end edges which are concentric and extend between the side edges which lie on radii of the end edges.

26. A method of making a container according to any of claims 20 to 24, wherein the mould cavity part corresponding to the peripheral wall corresponds to a wall which is polygonal in section at least adjacent the part corresponding to the end closure with the apices of the polygon radiused, and the part corresponding to the seam extends along an apex, the seam part having a section transverse to the direction extending between the end of the container having a relatively thick portion substantially centrally of the radiused apex and thinner portions on either side thereof extending transversely to the adjacent planar portions of the peripheral wall defining part of the cavity.

27. A method of making a container according to any of claims 20 to 34, wherein the mould cavity part which corresponds to the peripheral wall corresponds to a wall of polygonal transverse section at least adjacent the end closure, and the cavity includes parts corresponding to a rib along each apex of the polygon, one of which will form the seam and the blank includes wall panels defined by folds which lie at the rib defining parts of the cavity.

28. A method according to any of claims 20 to 27 in which synthetic plastic material is injected into the mould cavity part corresponding to the end closure to form a unitary one-piece moulding which includes the end closure.

29. A method according to claim 28 in which the cavity part corresponding to the end closure is shaped corresponding to an end closure having ribs radiating from the centre which are thicker than the end closure therebetween.

30. A method of making a container according to any of claims 20 to 27, wherein the end closure is formed in part at least from flexible sheet material.

31. A method according to any of claims 20 to 30 in which the mould cavity includes a part corresponding to a rib extending around the peripheral wall, intermediate the ends thereof.

32. A method of making a container comprising preparing an uncreased blank of flexible resilient material having concentric end edges and divergent side edges lying on radii from the centre of the end edges, deforming the blank to juxtapose the side edges and thereby form a peripheral wall bounding a region whose cross-sectional area decreases toward the shorter of the two end edges, constraining the deformed blank against its own resilience in a female mould tool, inserting a male mould tool into the female tool and trapping the blank between the tools so that the blank occupies a mould cavity part which corresponds to the container peripheral wall with the side edges adjacent another part which corresponds to a seam to be formed on the inner surface of the blank to unite the side edges, with one end edge adjacent a cavity part corresponding to an end closure, with the other end edge adjacent a cavity part which corresponds to a container lip including a free edge, a first part extending on the inner surface of the blank towards the end closure, and a second part projecting from the first part laterally of the container, the second part being of a thickness in the direction between the free edge and the end closure which is less than the thickness of the first part in the direction from the inside to the outside of the container, and with the blank spanning a part corresponding to a reinforcing rib extending between the end closure and the lip, injecting synthetic plastics material into the mould cavity parts unoccupied by the blank and removing from the mould cavity the complete container in which the moulding is a one-piece unitary moulding bonded to the blank, seaming the side edges of the blank, forming an end closure for the space bounded by the wall, constraining the blank at the open end of the container to the desired shape and providing reinforcement for the blank at the seam and at the rib.

33. A method of making a container substantially as herein described.

34. A container made in accordance with the method of any of claims 20 to 32.

35. A container substantially as herein described with reference to the accompanying drawings.

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1348370 AMENDED SPECIFICATION
8 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

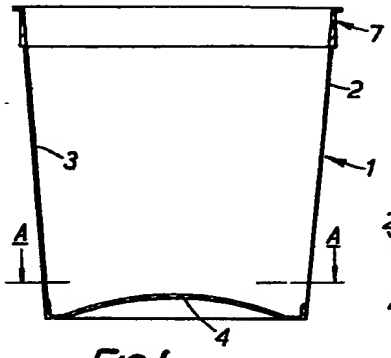

FIG.1

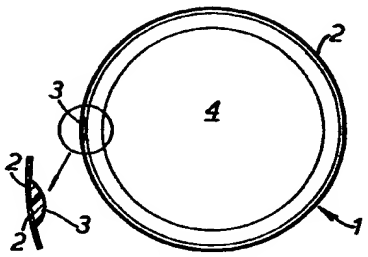

FIG.3

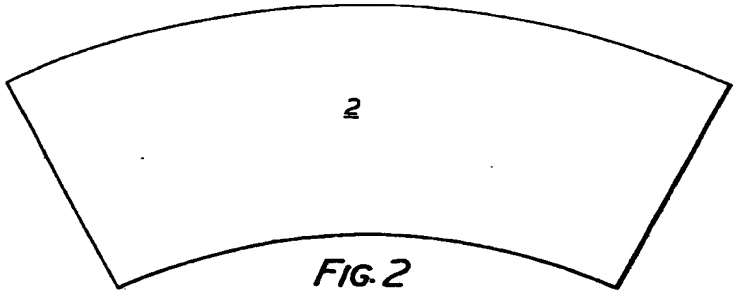

FIG.2

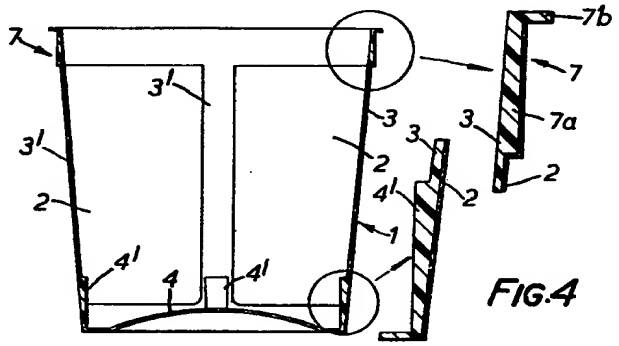

FIG.4

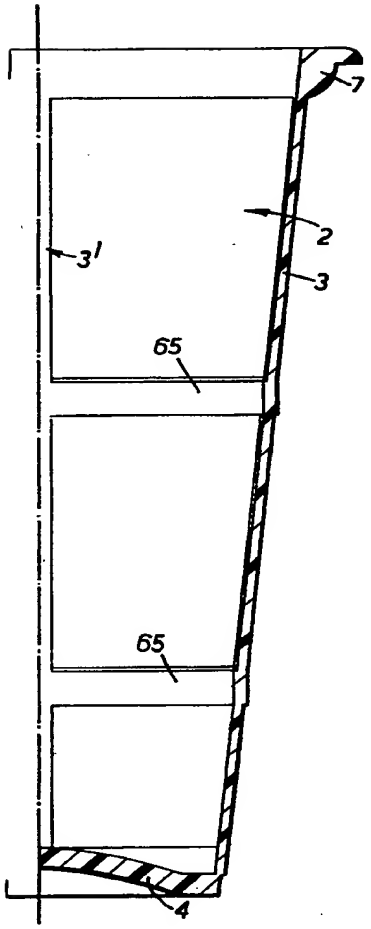

FIG. 5

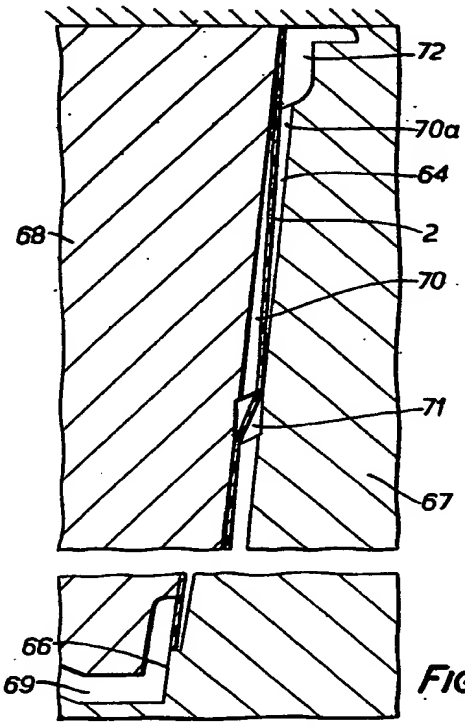

FIG. 6

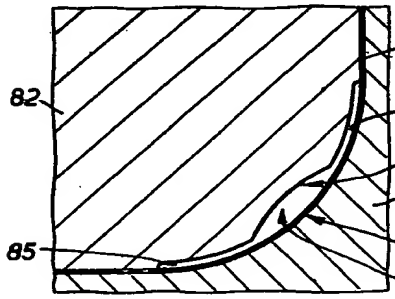

FIG. 10

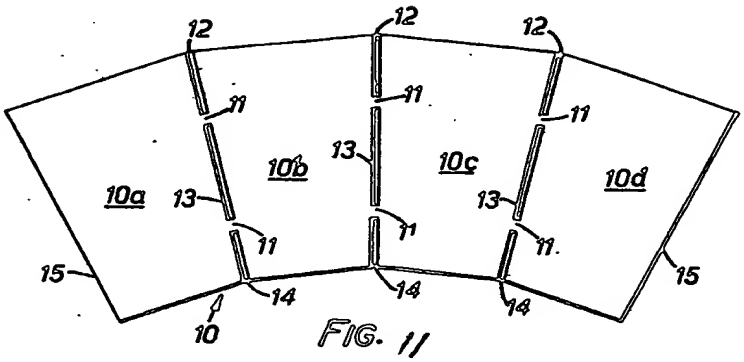

FIG. 11

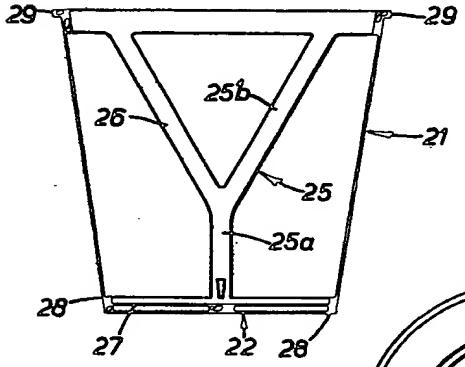

FIG. 7

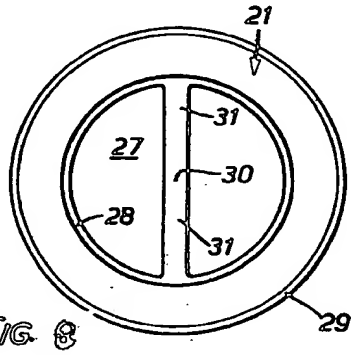

FIG. 8

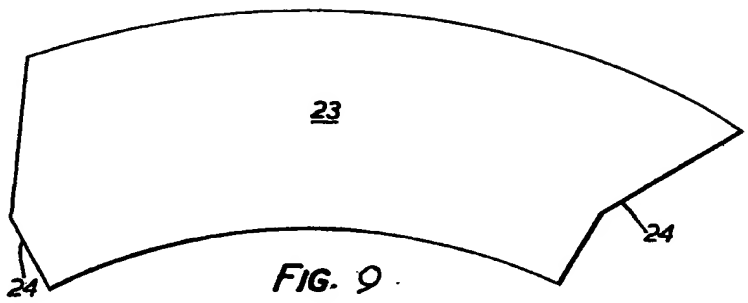

FIG. 9

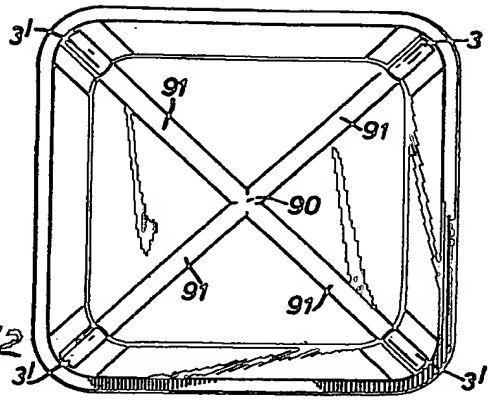

FIG. 12

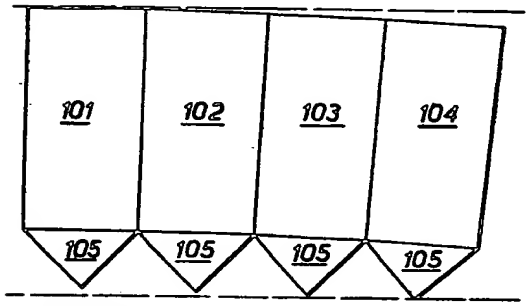

FIG. 13

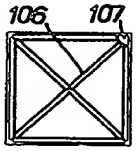

FIG. 14

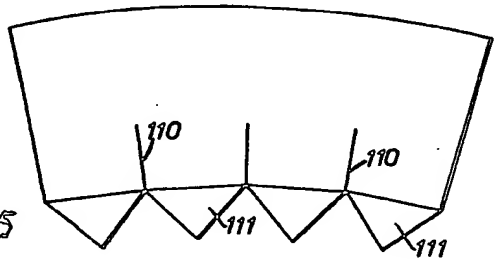

FIG. 15

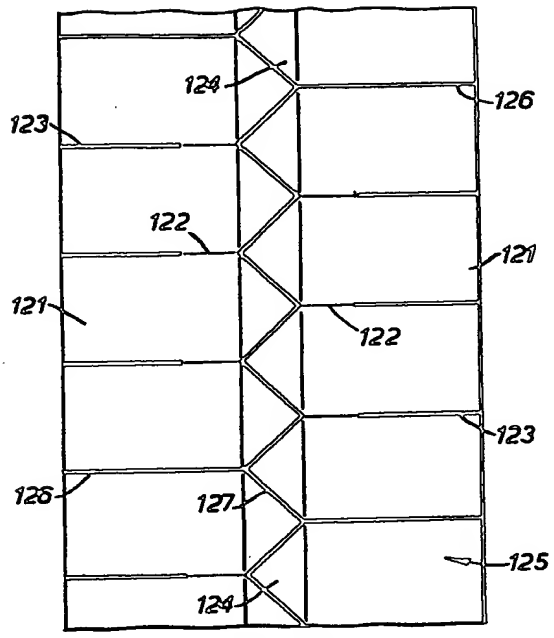

FIG. 15

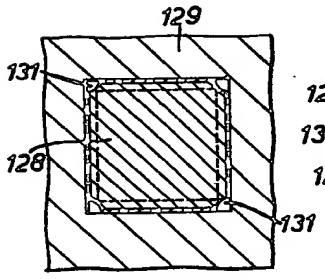

FIG. 17

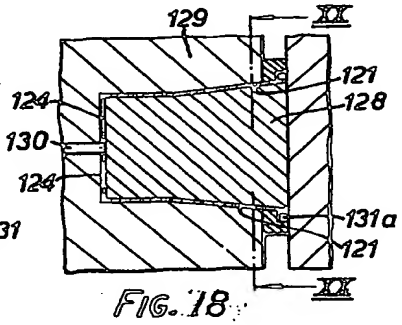

FIG. 18

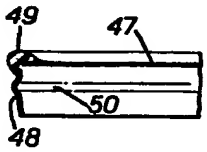

FIG. 19

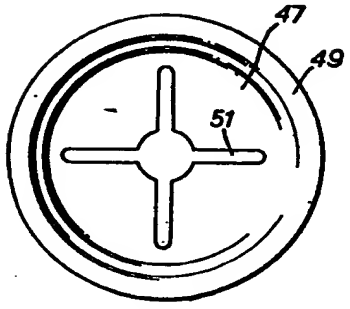

FIG. 20

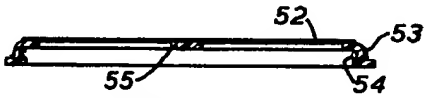

FIG. 21

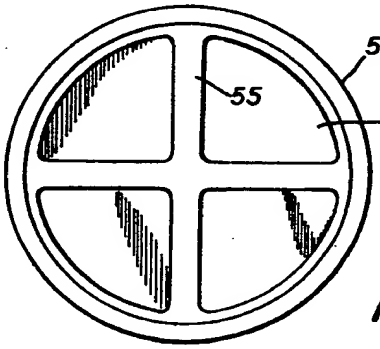

FIG. 22